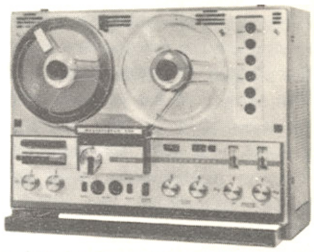
TELEFUNKEN

Service Information

M 204 E



Technical Data

Power Supply:	110, 127, 220 and 240 Volts, 50 Hz AC, switch-selectable, may be switched to 60 Hz
Power Consumption:	approx. 60 Watts
Tape Speed:	9.5 cm/s and 19 cm/s, switch-selectable
Track Arrangement:	4-track standard according to DIN 45 511 for monaural and stereophonic operation
Spool Size:	up to 18 cm diam., according to DIN 45 514
Playing Time:	4 x 120 min at 9.5 cm/s with 720 m double-play tape and monaural operation; playing time halved at 19 cm/s
Rewind Time:	about 5.5 min for 720 m double-play tape
Magnetic Heads:	1 record/playback head, G 415, 1 erase head, L 315
Bias Frequency:	85 kHz
Erase Frequency:	85 kHz
Equalisation:	according to DIN 45 513
Semiconductors Fitted:	
Transistors:	2 x AC 150, 8 x AC 122, 1 x AC 124 1 x AC 175, 2 x AC 123, 4 x AD 152 P
Rectifiers:	AEG B 30 C 1200/650 K 6
Diodes:	2 x OA 150
Inputs:	Radio: 2 x 0.15 mV across 2 kΩ Pickup (Phono): 2 x 150 mV across 2.2 MΩ Tape: 2 x 150 mV across 2.2 MΩ 2 x Microphone: 2 x 0.15 mV across 2 kΩ new input circuit Radio: 2 x 0.15 mV across 5 kΩ Pickup (Phono): 2 x 70 mV across 2.2 MΩ Tape: 2 x 70 mV across 2.2 MΩ 2 x Microphone: 2 x 0.15 mV across 5 kΩ
Outputs:	Radio: 2 x 1.5 V across 8 kΩ Earphones, mono: 0.5 V across 5 kΩ load Earphones, stereo: 2 x 0.5 V across 5 kΩ load Loudspeakers: 2 x 10 Ω (≧ 4 Ω)
Output Stages:	Push-Pull, 2 x 6 Watts music power
Frequency Range:	40 Hz to 17 kHz for 19 cm/s 40 Hz to 14 kHz for 9.5 cm/s
Dynamic Range:	47 dB for 19 cm/s 45 dB for 9.5 cm/s
Wow and Flutter (Pitch Fluctuations):	± 0.2 % for 19 cm/s ± 0.3 % for 9.5 cm/s } acoustic assessment, measured according to DIN 45 507
Harmonic Distortion Factor:	≦ 5 %
Loudspeakers:	built-in, 2 loudspeakers 100 x 180 mm, oval, may be switched off with switch-jack
Fuses:	2 x 0.4 A medium delayed 2 x 0.315 A medium delayed
Pilot Lamp:	subminiature lamp 24 V / 0.08 A, as on/off indicator
Dimensions:	standing upright, width x height x depth 475 x 365 x 225 mm with x 220 mm without } lid
Weight:	approx. 14 kg

Special Features:

May be operated in horizontal or vertical orientation. Completely independent controls for the two channels.

Mains Selection

The Model M 204 tape recorder may be set for alternative operation on 4 mains input voltages and two mains frequencies. The voltage selector switch and the two changeover lugs for the 50/60 Hz conversion are accessible after taking off the rear panel of the unit (3 cross-slot screws). For the 50/60 Hz conversion it is also necessary, after taking off the control knobs and the front panel, to place the motor belt into the appropriate groove of the motor pulley (small diameter for 60 Hz, large diameter for 50 Hz).

Maintenance

Cleaning the Cabinet Components

To clean the handle, use ordinary commercial cleaners for plastic. The choice wood casing should be cleaned with ordinary commercial polish based on water as solvent. An anti-static substance or device should be reapplied from time to time to the plastic components, se that these remain dust -repellent.

Cleaning the Tape Drive Components

Regularly remove deposits of tape dust. For this purpose, pull off the tape heads covering hood, and with a linen rag moistened with isopropyl alcohol, clean the tape guides, the drive capstan, the rubber pressure roller and the tape contact surfaces of the heads. Clean the perlon-silk pressure pad on the racord/playback head with a small dry brush. If this pad possesses hardened regions, it must be replaced (see hum suppression flap, replacement item).

Cleaning the Drive

From time to time as well as after any repairs to the drive mechanism, clean all drive components, the rubber brakes, the brake surfaces of the spool plates, as well as the capstan and the rubber pressure roller. For this purpose, use a clean linen rag moistened with isopropyl alcohol. (Methylated spirit is less suitable, since it is unable to dissolve molykote contaminations).

Oiling and Greasing

The unit is fitted with self-lubricating sintered bearings which give maintenance-free operating times of several thousand hours. If a bearing should happen to run with much friction, it is advisable to replace the component concerned. Re-oiling would bring about the danger of contaminating the drive with oil spray.
The sliders of the actuator rods and the bearing brackets should be lubricated at the bearing points with Siemens uniselector grease, and with Molykote Paste G Rapid at all places where metallic components slide against each other (e. g. the press-button assembly). The prismatic bearing for the drive capstan on the head carrier plate is also lubricated with molykote. Re-greasing is necessary only after replacing components, or when a particular component does not run freely. Molykote must always be applied as an extremely thin film. Lubricating grease or molykote must not be used for sintered bearings.

Demagnetisation (Degaussing)

Tape drive components and magnetic heads may become magnetised when approached with magnetic tools or cables carrying direct current. This produces a permanent background noise on the tapes during operation. To prevent this defect, we recommend careful and thorough degaussing of all metallic components which come into contact with the tape, after every completed repair job (degaussing choke for 220 V AC, Order No. 60.89.108).
All adjustment values and direction specifications refer to vertical operation of the unit.

Operating Instructions

Track Selection: The function selector switch ⑫ is blocked in the "Recording" operating mode, so that track selection must be made in the "Stop" or "Playback" settings.

Stereo:	Turn switch ⑫ to position "Stereo".
Mono:	Turn switch ⑫ to position "1" or "2".
Parallel:	Turn switch ⑫ to position "P"; only for parallel playback of both tracks.
Multi-Play:	Turn switch ⑫ to position "2/1" or "1/2", according as to whether transcription is to be made from track 2 to track 1, or from track 1 to track 2 respectively. The drive level of the new recording is always to be adjusted with the control ⑭ and the drive level of the transcription recording is always to be adjusted with the control ⑬.

Recording. Turn the function selector switch ⑫ to the desired setting and press the recording button ㉔. Then adjust the drive level for monaural recordings with the control ⑭, and for stereophonic recordings with control ⑭ for the left channel and control ⑬ for the right channel. The meter pointers should deflect up to the start of the red sectors on volume peaks, excursions into the red sectors being at most very brief. After correct drive adjustment, hold the recording button ㉔ depressed and press the drive button ㉖ additionally thereto.

The stop button ㉘ must be actuated prior to any change of the operating mode.

Manual Controls and Connecting Jacks

① Connecting jack for radio receiver (mono/stereo or VHF stereo tuner) or separate Hi-Fi stereo amplifier
② Connecting jack for record player (mono/stereo), also for Hi-Fi record player with built-in equaliser-preamplifier.
③ Connecting jack for monaural earphones for "silent" monitoring during monaural recordings.
④ Connecting jack for stereophonic earphones for "silent" monitoring during stereophonic recordings.
⑤ Connecting jack for separate Hi-Fi loudspeaker box (left channel); or jack for Hi-Fi earphones.
⑥ Connecting jack for separate Hi-Fi loudspeaker box (right channel); or jack for Hi-Fi earphones.
⑦ Insertion slot for tape.
⑧ Rapid stop button, can be latched.
⑨ 3-digit counter mechanism, counts forwards and backwards, resettable to zero with pressbutton.

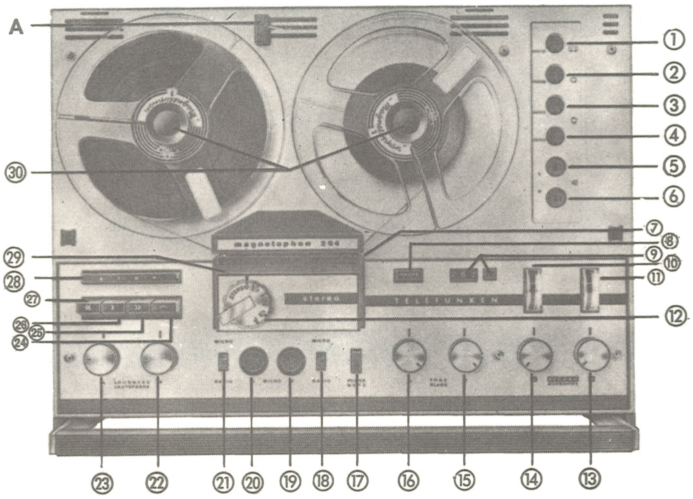


Fig. 1 Connecting Jacks and Manual Controls

⑩ VU-meter for checking the recording drive (for stereo = left channel; for mono and transcription = indication only on this meter);
at the same time serves as illuminated on/off indicator.
⑪ VU-meter for checking the recording drive (for stereo = right channel; for mono transcription no indication on this meter); at the same time serves as illuminated on/off indicator.
⑫ 6-position function selector switch for stereo/mono/transcription and prallel playback.
⑬ Recording drive level control (for stereo = right channel; for transcriptions = transcription level control).
⑭ Recording drive level control (for stereo = left channel; for mono = drive level adjustment only with this control; for transcriptions = mixer control).
⑮ Tone control, for stereo for the right channel, for mono for the right power amplifier.
⑯ Tone control, for stereo for the left channel, for mono for the left power amplifier.
⑰ Mains switch, on/off.
⑱ Input selector switch Microphone — Radio/Phono; for stereophonic recordings for the right channel, for monaural recordings setting of this switch without significance.
⑲ Connecting jack for stereophonic microphone, right channel (for microphones plugged-in separately). Without significance for monaural recordings.
⑳ Connecting jack for stereophonic microphone, left channel (for microphones plugged-in separately), or for stereophonic microphone with only one plug (left and right channel), or for microphone for monaural recordings.
㉑ Input selector switch Microphone — Radio/Phono; for stereophonic recordings for the left channel, for monaural recordings this switch alone is effective.
㉒ Volume control for playback via power amplifier (for stereo = right channel, for mono = right power amplifier).
㉓ Volume control for playback via power amplifier (for stereo = left channel, for mono = left power amplifier).
㉔ Recording button (blocks the function selector switch ⑫).
㉕ Button for fast forward drive.
㉖ Tape drive button; press alone for playback; press in addition to button ㉔ for recording.
㉗ Button for fast rewind.
㉘ STOP button (actuation of this button causes other buttons to jump back to resting state).
㉙ Guide rail for splicing tapes.
㉚ Rubber caps for retaining the spools during vertical operation of the unit.
A Tape speed selector 19 cm/s — 9.5 cm/s (operate only when the unit is switched on).

To Open the Unit

Before opening the unit, withdraw the mains plug from the power socket.

To take off the floor

Screw out the three cross-slot screws of the metallic floorplate and the two screws of the coverplate. Take off the floorplate and pull the mains plug through the opening.

To fold out the amplifier board

Screw out the four retaining screws of the amplifier board (at the yellow triangular spacers). Fold out the amplifier board.

To take out the output stage assembly

Screw out the three retaining screws of the printed circuit board (in the black triangular spacers) and the two fixing screws of the cooling fin. Take out the assembly.

To take off the head covering

Using both hands, press downwards the sidewings of the head covering close above the coverplate, and pull off the head covering forwards.

To take off the coverplate

Pull off the six control knobs and the knob of the function selector switch forwards, and pull off the rectangular knob of the tape speed selector in the direction of the changeover lever. The coverplate can then be taken off after releasing the six cross-slot screws.

Six-Jack Bracket

Screw out four screws in the chassis from the front. Fold out the jacks bracket (it is not necessary to take off the mask).

Switch and Jack Bracket

Screw out two screws from the rear side of the chassis, release the anchorage of the mains cable, pull out the jacks bracket through a small distance and turn through 180°. The wiring is then accessible.

Construction and Functional Principles

The complete mechanism of the magnetophon 204 is built on a sheet metal chassis which is screwed to the wooden cabinet frame.

Engagement Plates

The engagement plates engage with their three latching pegs into the bayonet slots of the slip plates. They should be engaged by turning towards the magnetic heads. To disengage them, turn in the other direction, but not too far since otherwise the plates latch again. To latch or unlatch the plates, hold the slip plate and engage or release the engagement plate with the help of a small tape reel.

The tension ring below the engagement plate should be mounted with a play of 0.2 to 0.3 mm with respect to the slip plate.

Feed Plate Assembly (on left, looking onto chassis)

The components are listed in order, commencing at the bottom as seen looking onto the chassis: —
Slider for elevation adjustment of the feed plate
Profile block to compensate the inclined plane of the slider
Plastic washer
Lockwasher, bronze washer and star spring
Supporting plate
Lockwasher, bronze washer and star spring
Brake plate with felt lining
Slip plate with felt lining and injected bushing with bearing
Plastic washer, bronze washer and tension ring
Engagement plate

Take-Up Plate Assembly (on right, loocking onto chassis)

The components are listed in order, commencing at the bottom as seen looking onto the chassis: —
Slider for elevation adjustment of the take-up plate
Profile block to compensate the inclined plane of the slider
Plastic washer
Lockwasher, bronze washer and three star springs
Supporting plate
Lockwasher, bronze washer and one star spring
Brake plate with felt lining
Slip plate with felt lining and injected bushing with bearing
Plastic washer, bronze washer and tension ring
Engagement plate

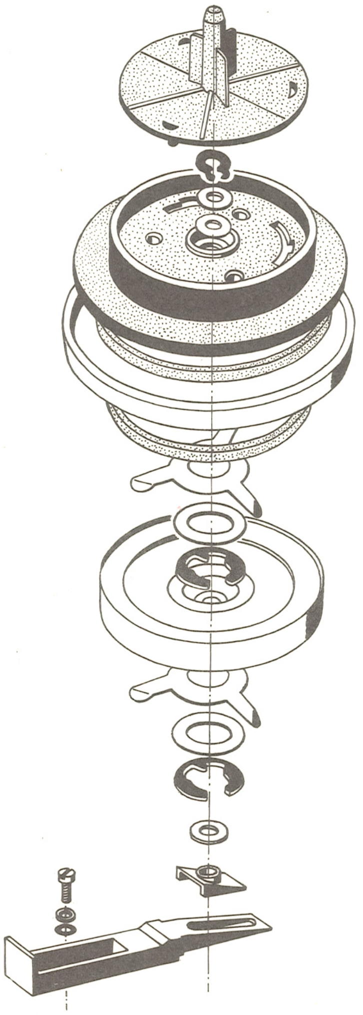


Fig. 2 Exploded drawing of feed plate (left)

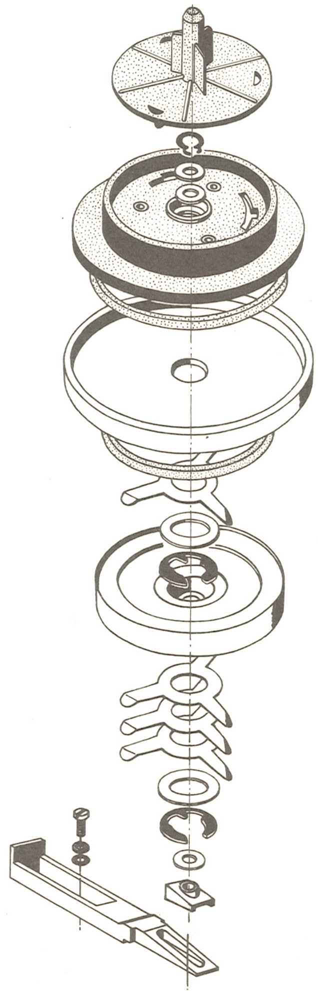


Fig. 3 Exploded drawing of the take-up plate (right)

Functional Principles of the Drive Mechanism

The unit employs a round profile belt drive. The symmetrical shaded pole motor drives the motor belt, which in turn drives two intermediate wheels and a switching wheel. The flywheel disc is driven from this switching wheel, via the drive belt.

For tape drive speed changeover, a switching rocker throws the drive belt into the other groove on the switching wheel and on the flywheel disc.

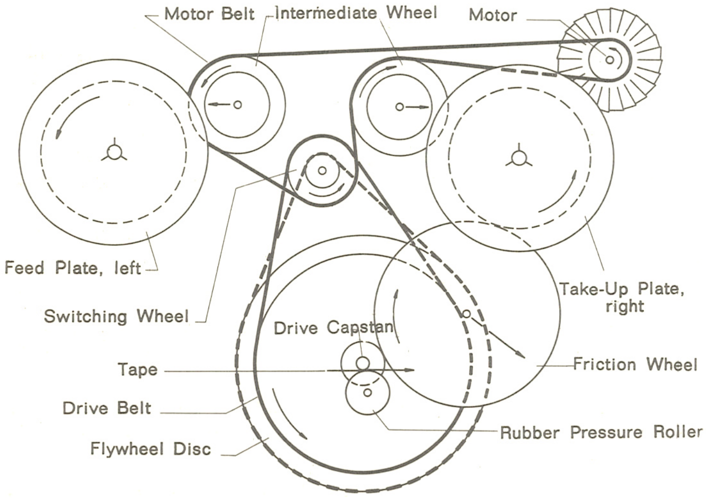


Fig. 4 Schematic depiction of the drive mechanism

Important:

The tape drive speed may be switched over only when the unit is switched on.

Recording — Playback

When the tape drive button is pressed, the stop brakes release the feed and take-up plates. The friction wheel is pulled in between the flywheel disc and the supporting plate of the right take-up plate assembly, so that it drives the right brake plate via a slipping clutch.

On the left feed plate assembly, an auxiliary brake restrains the supporting plate, so that the left slipping clutch becomes effective. This slipping clutch consists of the supporting plate and the felt ring below the brake plate.

Fast Forward Drive

When the fast forward drive button is actuated, the stop brakes release the feed and take-up plates. The auxiliary brake is applied to the left supporting plate. The rubber coating of the right intermediate wheel is pressed against and thus drives the right brake plate. Excessive starting tension is not exerted on the tape, because this is prevented by the tape protection coupling between the brake plate and the slip plate.

Rewind Drive

Once again, the stop brakes release the feed and take-up plates when the rewind button is actuated. The brake releases the left supporting plate and the rubber coating of the intermediate wheel is pressed against and drives the left brake plate. The tape protection coupling on the left plate serves the same function as the one on the right plate. The tape tension is established with the felt brake below the right take-up plate.

Replacement of Componets and Mechanical Adjustments

Replacing the Motor Belt

After unhooking the tension spring, fold up the switching rocker towards the head carrier plate. Twist the leaf spring from its normal resting position towards the head carrier plate and place the motor belt into the upper groove of the switching wheel, over the intermediate wheels and into the lower groove of the fan wheel (for 60 Hz operation, into the upper groove of the fan wheel). Make sure that the motor belt runs approximately parallel to the chassis into the groove.

Replacing the Drive Belt

Take off the right take-up plate and screw out the three fixing screws 1, 2 and 3 (Fig. 5) of the head carrier plate. Pull off the head carrrier plate upwards from the drive capstan (the plastic prismatic bearing of the drive capstan remains in the head carrier plate).

After unhooking the tension spring, take out the switching rocker, and take the motor belt off the switching wheel.

Insert the new drive belt, first of all into the upper groove of the flywheel disc, then into the lower groove of the switching wheel, with the tape drive speed selector set to 19 cm/s. Reinsert the switching rocker and make sure that the drive belt rests in the two cut-aways.

Remount the head carrier plate onto the drive capstan. Check that the plate rests securely on its supports and that the lever of the pressbutton assembly lies in front of the slider (F) of the plate. Tighten the screws in the order 1, 2, 3 as specified on Fig. 5. If the dust protection ring has become displaced, press it down only to such an extent that a clearance of about 0.5 mm still remains with respect to the prismatic bearing in the head carrier plate. The dust protection ring must not touch the upper edge of the rubber roller.

If the dust protection ring scrapes against the bearing or against the rubber roller, this would produce pitch fluctuations and rumble. Clean the drive capstan with isopropyl alcohol.

Carry out a functional check.

Tape Alignment

The feed and take-up plates, the tape guides and the record/playback head as well as the erase head, are adjusted to a uniform height in the factory. As a rule, readjustment is necessary only after components have been replaced.

Feed and Take-Up Plates

The feed and take-up plates can be adjusted in height with respective sliders. They should be adjusted such that the tape runs in centrally between the flanges of the tape spools.

Erase Head

The height of the erase head can be adjusted by turning the screw (G). The adjustment should be made such that the upper edge of the core extends about 0.1 mm above the upper edge of the tape.

Record/Playback Head

The height of the record/playback head can be adjusted with two grubscrews (C). The upper edge of the core packet in the record/playback head should be flush with the upper edge of the tape. Furthermore, it is important to make sure that the head face is vertical, i. e. that it is aligned parallel to the drive capstan. After every mechanical readjustment, the head must be rocked-in (screw D) with the help of a test tape.

Rubber Roller Pressure Lever (RP-Lever)

Clearance of Roller Holder

When the tape drive button (start button) is pressed, the long thrust rod for the head carrier plate mechanism is moved via an actuator bracket. It is thereby important to make sure that the lower sheet metal section of the RP-lever rests firmly against the second tape guide (with slight excess excursion) when the start button is pressed. If this condition is not satisfied, then the excursion of the thrust rod must be adjusted accordingly, by inserting metal washers between the actuator bracket and the thrust rod.

The spring-loaded roller holder should have a clearance of about 1 mm with respect to the right edge of the RP-lever in the pressed-in state, in order that the rubber pressure roller can operate without hindrance.

On the right, the clearance of the roller holder with respect to the rapid stop lift-off device should be about 2 mm.

Measuring and Adjusting the Rubber Roller Pressure

Measurement: The pressure of the rubber roller should be measured with a tape inserted and the tape drive button depressed. Apply a contactor or a spring balance (1000 p) to the right end of the roller holder. Therewith lift off the rubber roller from the tape and drive capstan, and slowly return it to the tape, parallel to the drive capstan, until the tape just commences to run. The reading should then be 660 to 730 p, corresponding to a roller pressure of 900 to 1000 p.

Adjustment: The force of the pressure spring can be adjusted by turning the nut (H).

Fast Forward Drive

In the "Stop" setting, the clearance between the right intermediate wheel and the right engagement plate should be greater than 0.5 mm. The tension spring for the fast forward drive should be hooked in such that a force of 1100 ± 100 p results when the right intermediate wheel engages the brake plate. This force must be measured with a contactor at the measuring point opposite to the hook-in toothing on the lever. The fast forward drive button must not be pressed for this measurement.

Fast Rewind

In the setting "Stop", the clearance between the left intermediate wheel and the left engagement plate should be greater than 0.5 mm.

Measuring the Friction Wheel Pressure

The friction wheel is situated between the right take-up wheel and the flywheel disc.

During playback, the force with which the intermediate wheel is pulled against the flywheel disc and the take-up plate should lie between 160 and 200 p, as measured in the direction of the pull-in force at the measuring point A.

When the unit is lying horizontal, these values increase by about 50 p (self weight of slider).

The intermediate wheel slider must move lightly.

Slipping Clutch (50 mm diameter measuring spool)

The upper slipping clutch in the feed plate and take-up plate assemblies is adjusted with the star spring such that a slip torque of 1100 to 1500 pcm is obtained, corresponding to a force of 440 to 600 p.

The slip torque of the lower slipping clutch of the left feed plate assembly should lie between 100 and 140 pcm, corresponding to a force of 40 to 60 p.

The lower slipping clutch in the right take-up plate assembly is adjusted with the three star springs such that a slip torque of 330 to 470 pcm is obtained, corresponding to a force of 130 to 190 p.

The auxiliary brake on the right bottom feed plate is adjusted with the tension spring such that the braking torque in the rewind setting is 100 to 180 pcm, corresponding to a force of 40 to 70 p.

Measuring the Tape Tension

The felt pad pressure on the record/playback head should be 40 to 60 p. The following tape tension values are permissible for recording and playback operation:

at start of tape: greater than 30 p
at end of tape: less than 140 p

The measurement should be made during playback operation. The rubber pressure roller must thereby be lifted off the drive capstan. After inserting a full or nearly empty 18 cm diam. tape reel, respectively, pull the tape with hooked-in spring balance (250 p) past the heads and the drive capstan to the right, with about the nominal speed of 9.5 cm/s.

The tape tension fluctuations over any one full revolution of the left engagement plate should not exceed ± 5 p about the mean value.

Brakes

It is important to ensure that the brake linings and the brake surfaces of the feed and take-up plates are clean. When necessary, they must be cleaned with isopropyl alcohol. In the resting state, the stop brakes must wedge-in securely. In order to ensure this, a clearance of 1 mm must exist between the ends of the brake slider plate and the brake levers at the points E. Adjust the sheet metal ends accordingly. With the tape drive button actuated, the clearance between the brake rubber and the feed or take-up plate must be greater than 1 mm.

The auxiliary brake on the supporting plate of the left feed plate assembly must lift off when the rewind button is pressed. In all other operating states, the auxiliary brake must restrain the supporting plate.

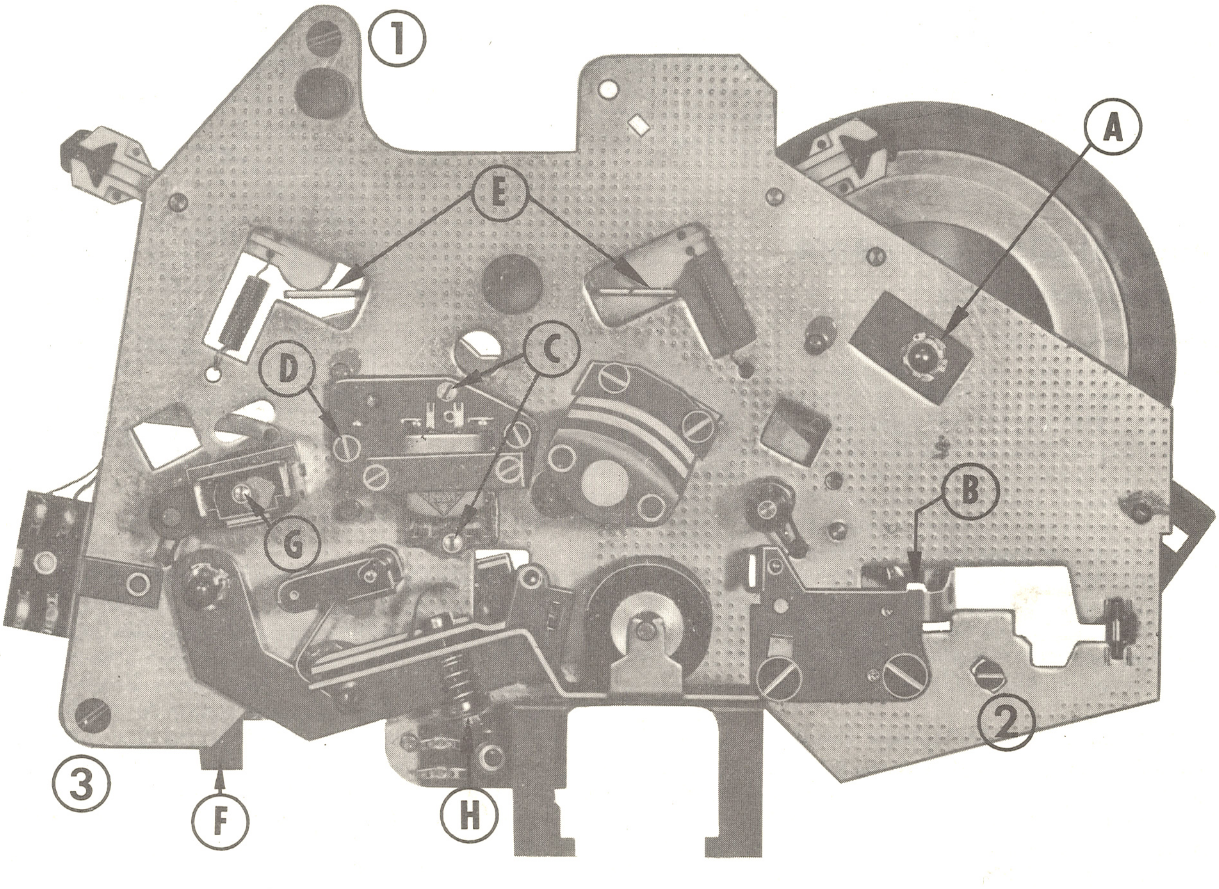


Fig. 5 Depiction of the head carrier plate

Quick Stop

When the quick stop button "Pause" is actuated, the left feed plate assembly is restrained with the cork auxiliary brake, the tape transport is arrested by lift-off of the rubber pressure roller, and then the right take-up plate is stopped by lift-off of the friction wheel from the flywheel disc.
A functional check of this process can be made by pressing the quick stop button slowly. If the given order of events is not maintained, then the tab (B) which points from the quick stop plate towards the chassis must be bent accordingly.

Adjusting the Tape Speed Selector Mechanism

When the selector toggle lever is actuated, the metal slider for the equaliser changeover switch is moved at the bottom, and the switching rocker for the belt is moved at the top. The metal slider for the equaliser changeover switch must move lightly. It should jump immediately to the final setting when switching over. If necessary, the glide points of the slider should be lubricated with Molykote Paste G Rapid.
The belt switching rocker must be adjusted such that the belt does not scrape against the rocker in either one of the two tape speed settings. If necessary, adjust as follows: first of all switch to 19 cm/s and adjust the long leg of the switching rocker such that the belt runs centrally in the slots of the rocker.
Then repeat the same adjustment after switching over to 9.5 cm/s, but in this case judiciously bend the adjustment nose of the toggle lever which bears against the switching rocker.

Adjusting the Drive Capstan Bearing Block

Adjustment is here necessary when the bearing block has been released or replaced. The drive capstan runs at the top in a plastic prismatic bearing and at the bottom in a self-aligning sintered bearing. The capstan has a play of about 0.5 mm in the upper bearing as long as the drive button is not actuated. The drive capstan is pressed into the prismatic profile and thereby takes up its precise nominal position parallel to the magnetic heads and tape guides, only when the drive button is actuated and the rubber pressure roller pushes the capstan against its bearing.
The adjustment should be carried out with the drive button (start button) pressed and with the screws of the bearing block tightened moderately.
For this purpose, use a depth gauge to measure the clearance between the head carrier plate and the turned step of the flywheel disc at three well spaced points. If these clearances are unequal, make them equal by adjusting the bearing block accordingly.
If a repair task makes it necessary to release the bearing block, it is advisable first of all to mark its position on the head carrier plate, using a scriber.

Electrical Measurements and Adjustments

Measuring Equipment

Universal Multimeter (internal resistance about 50 kΩ/Volt), AF Signal Generator, AF-VTVM or Voltage-Calibrated Oscilloscope, AEG-TELEFUNKEN Test Tape (Order No. 50.89.107).
N. B.: For signal injection from the AF signal generator for the following measurements, pins 2 and 3 on the phono jack are used for channel 1 and pins 2 and 5 for channel 2. The voltage levels here required are readily obtained directly from the AF signal generator, without special voltage divider. Furthermore, this practice avoids false readings which could otherwise result from ground loops between the AF signal generator and the tape recorder when injecting signals into the sensitive input. All the measurements described below are to be made in the setting "Stereo" at 9.5 cm/s tape drive speed.

Rocking-In the Record/Playback Head

Before inserting the test tape, degauss the heads and tape guides. Insert the test tape, rewind it completely once in each direction, and connect the VTVM to the radio jack (pins 2 and 3 or 2 and 5). With the screw (D) of the rocker plate, first of all adjust the head coarsely during playback of the 1 kHz measuring tone, and then adjust it finely during playback of the 12 kHz measuring tone. These adjustments must be made separately for the top and bottom channel. If the voltage maximum setting for the one channel does not correspond exactly to that for the other channel, finally set the head to a position about midway between the respective maxima.

Checking the Playback Frequency Response

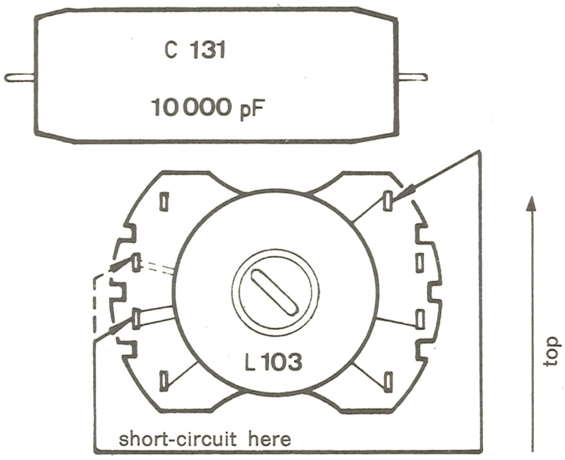
Insert the test tape and connect the VTVM to the radio jack (pins 2 and 3 or 2 and 5). Take readings during playback of the test frequencies 80 Hz, 1 kHz, 10 kHz, 12 kHz (— 20 dB). The readings obtained should not differ by more than ± 3 dB with respect to the reading for 1 kHz. Check for both channels. If the two channels give different readings for the 1 kHz reference signal level (full level), correct by adjusting the potentiometer R 219. This matches channel 2 to channel 1.

Adjustments of the Equaliser Coils and Checking the Recording Preemphases

Connect the AF signal generator to the phono jack (pins 2 and 3) and the VTVM to the stereo earphones jack (pins 2 and 3). Short circuit points 1 and 6 of the oscillator coil, turn up the drive level control to maximum and switch the unit to recording.
Inject a 1 kHz signal at such a level (about 10 mV) that the VTVM reads 150 mV. Without altering the input level, then tune the AF signal generator to 14.5 kHz. Adjust the core of the coil L 102 for maximum voltage reading. The voltage reading then obtained on the VTVM should increase by about 14 to 20 dB (to 0.75 to 1.5 V) at 14.5 kHz, and by about 0 to 3 dB (to 150 to 220 mV) at 50 Hz.
The measurements must be repeated for the second channel, with signal injection at the phono jack (pins 2 and 5) and the VTVM connected to the stereo earphones jack (pins 2 and 5). In this case, the coil L 202 should be adjusted.

Adjusting the Tuned Trap Coils, L 101 and L 201

This adjustment is necessary when oscillator components or the erase head have been replaced. Connect the VTVM to L 101 / R 113 or to L 201 / R 213 and chassis, and switch the unit to recording. Adjust the core of the coil L 101 or L 201 for maximum voltage reading.



looking onto the components side
of the amplifier board

Fig. 6 Short-circuiting the oscillator coil

Checking the Frequency Response „Over Tape"

For the recording process, connect the AF signal generator to the phono jack (2 and 3); for the playback process, connect the VTVM to the radio jack (2 and 3). Insert the test tape and wind forwards up to the unrecorded section. Switch the unit to recording, turn up the drive level control to maximum, and with an input voltage of 5 mV first of all record at 1 kHz and thereafter at 14 kHz. These two frequencies should be reproduced at the same level during playback. If the playback levels are found to differ, repeat the recording after slight displacement of the bias trimmer C 12 for channel 1.
Reduction of the trimmer capacitance: increased treble response
Increase of the trimmer capacitance: decreased treble response
These measurements and adjustments must be carried out

analogously for the second channel too. (Adjustment of the bias trimmer C 22, recording input at phono jack, pins 2 and 5, and playback output at radio jack, pins 2 and 5).

It is advisable to carry out a check measurement of the frequency response at 19 cm/s tape drive speed.

Here the level for 1 kHz may show a maximum discrepancy of ± 3 dB with respect to the level for 15 kHz, corresponding to a voltage ratio factor of 0.7 to 1.4 at 1 kHz.

Adjusting the Recording Level

The recording drive manual controls must be set to maximum for the following adjustments.

Adjusting the VU-Meters in the Stereo Setting

Connect the VTVM to the stereo earphones jack alternately to pins 2 — 3 and 2 — 5. From the AF signal generator, feed a signal at 1 kHz into the phono jack, pins 2 — 3 and 2 — 5, at such a level (about 225 mV) that the VTVM indicates 2 V on channel 1. Check by transferring the VTVM to channel 2; the reading here should also be 2 V. With this input voltage, adjust the preset controls R 151 and R 251 such that the pointers of the VU meters are on the dividing lines between the red and black sectors.

Adjusting the Recording Level for Stereo

Without changing the input voltage, make a stereo recording on the free section of the test tape. Upon playback, channel 1 as well as channel 2 should both give the noted test tape level + 3 dB. In case of discrepancy, repeat the test recordings after having appropriately readjusted the preset potentiometer R 102 for channel 1 or the preset potentiometer R 203 for channel 2.

Adjusting the Recording Level for Mono 2

Without changing the input voltage, make a recording on the free section of the test tape. Playback of this recording should again produce the test tape level + 3 dB. If this is not the case, repeat the test recording after appropriate readjustment of the preset potentiometer R 103.

Alignment of the Output Stages

Measure in the playback seting without signal.

The collector-emitter voltages should be equal (center-point voltage) in both of the two output stages.

Alignment of the Oscillator Frequency

In the setting "Stereo" recording, tune the oscillator coil L 103 such that the oscillator runs at 85 kHz (± 4 kHz).

Circuit Description

Connection of the amplifiers to the heads and output stages:

Parallel:	Both head systems are connected to the parallel-connected amplifiers. Both output stages are driven from the amplifier 1.
Stereo:	Each head feeds one respective amplifier chain. The output stages can be used to monitor the signals ahead of the tape during recordings.
Mono:	The particular selected head system (1 or 2) is connected to amplifier 1 and both output stages are driven from amplifier 1. For recording, only amplifier 1 switches to recording and the output stage 1 serves for monitoring during recording, whilst the output stage 2 is then switched off. The other (nonselected) head system is connected to amplifier 2.
Multi-Play:	According to the direction of transcription, the signal pick-up (playback function) head system is connected to amplifier 2, which remains in the playback setting, whilst amplifier 1 switches to recording when the recording button is pressed. The mixed signal can be monitored via the output stage 1. The output stage 2 is switched off.

Earphones Outputs

The signals being handled by amplifier 1 can be monitored at the mono and stereo earphones output, whereas the signals being handled by amplifier 2 can be monitored only at the stereo earphones output.

Amplifiers

The combined recording and playback amplifier is a five-stage circuit for each channel. The input stage (T 101 / T 201) is driven directly via a coupling capacitor (C 102 / C 202) for radio or microphone recordings. For recordings from a record player or tape source, the input voltage is reduced via a 2.2 MΩ series resistor (R 1 / R 2). Current negative feedback is applied to this stage via an unbypassed emitter resistor, and also AF negative feedback is applied from the output to the input. This establishes the dynamic input impedance. The stage will accept signals 40 dB greater than normal without overloading, and it possesses a favourable signal/noise ratio. The drive level control (separately R 11 and R 21) lies beyond the input stage. R 11 is used to adjust the drive level for the monaural recording functions. R 11 also serves as drive level control for the new recording in the multi-playback setings, irrespective of whether this recording is taking place on channel 1 or on channel 2. Similarly, the volume of the channel to be transcribed (1 or 2) is always adjusted with R 21. A buffer stage with collector output (T 102 / T 202) lies ahead of the equaliser. The gain of this stage in channel 2 can be adjusted with R 219 for playback, in order to compensate once and for all for differences in sensitivity of the record/playback heads 1 and 2. Furthermore, the sensitivity switching between playback and recording is effected in this stage.

A switched RLC-network provides equalisation for recording/playback and 19/9.5 cm/s tape speeds. This network is connected between the output (C 124 / C 224) and the emitter resistor (R 133 / R 233) of the first equaliser transistor (T 103 / T 203). Among other functions, this equaliser circuit provides strong treble lift for the recording process and it also ensures a level overall frequency response. The next stage (T 104 / T 204) compensates for the gain loss produced by the equaliser circuit. The final stage is an emitter follower (T 106 / T 206) and provides a low output impedance of the amplifier, so that the driver stage for the output stage and the VU-meter circuit can be connected here. In the multi-play settings of the function selector switch (S 3 / S 4 / S 6), the coil in the equaliser network previously connected in parallel with the emitter resistor of the equaliser transistor, is now disconnected from chassis, but only in the amplifier serving for playback (always channel 2). The treble lift is therewith removed in this amplifier and the tendency to instability reduced. In addition, a RC combination (R 9 / C 23) directly at the playback head damps out any parasitic oscillation otherwise produced. The signal to be transcribed is fed via R 118 / C 111 to the base of the equaliser transistor of the recording amplifier (always channel 1). The recording voltage is coupled out via C 126 / C 226 and fed via a tuned trap (L 101 — C 104 / L 201 — C 204) and an adjustable series resistor (R 102 / R 103 / R 203) to the record/playback head 1 or 2. The tuned trap prevents the bias voltage, which is also applied to the recording/playback head, from sending a current back into the amplifier. The series resistors serve for setting the AF voltages in the recording process such that the playback levels are equal for the various operating modes.

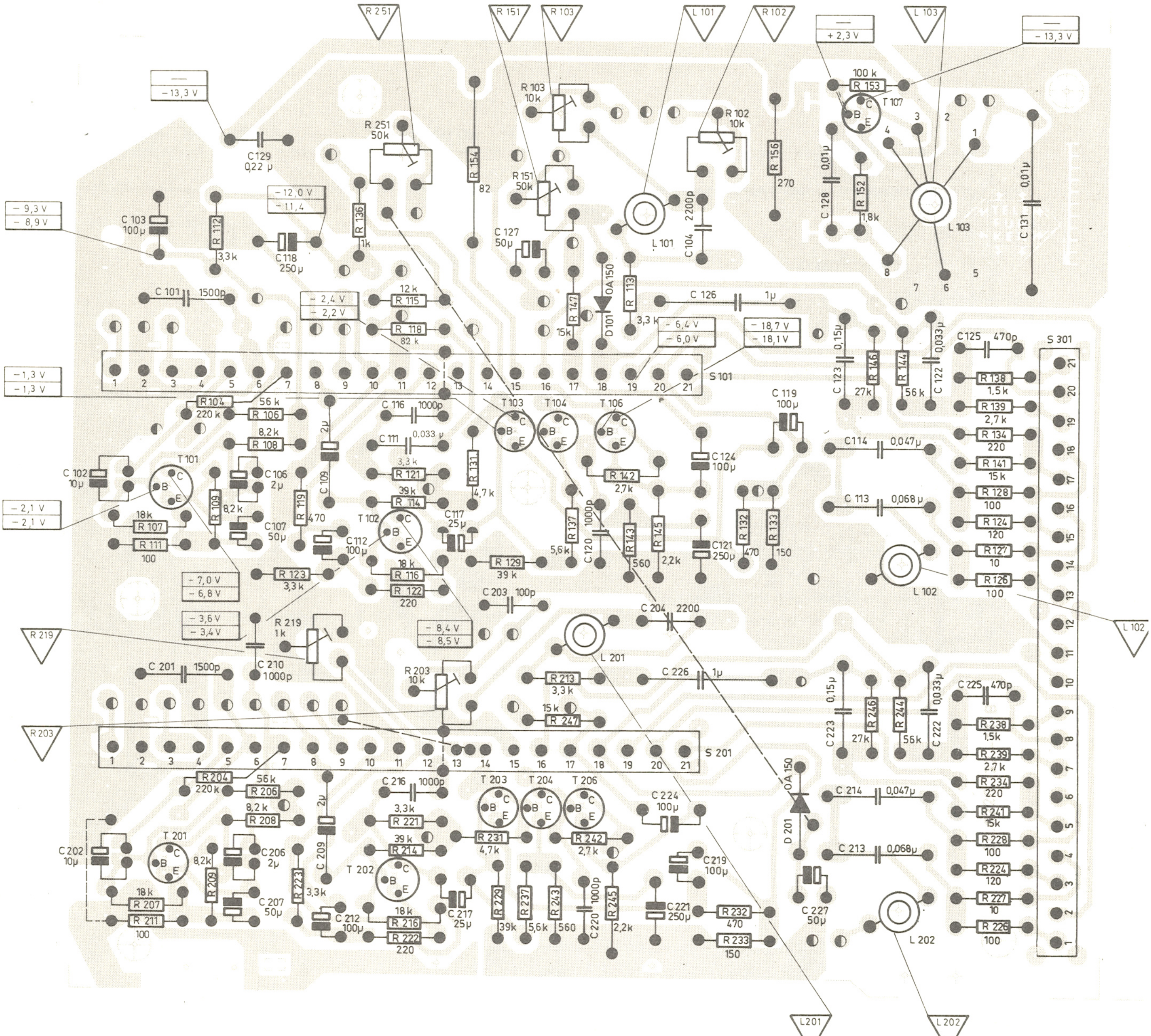
The Output Stages

The output stages are driven from the recording/playback amplifier, via respective volume controls (R 12 / R 22) and tone controls (R 31 / R 41). The driver stage operates into an interstage transformer. The driver stage is stabilised with an emitter resistor (R 307 / R 407). The pnp power transistors (T 302, 303 / T 402, 403) are driven in antiphase from the respective transformers (TR 301 / TR 401). The loudspeaker is coupled to the center point of each output stage, via a large electrolytic capacitor (C 306, C 406). The output transistors are connected in series for DC considerations, so that a 47 Ohm NTC resistor is required in each base circuit. The 56 Ohm resistor in parallel therewith gives the stabilisation curve the required form. The harmonic distortion factor is further reduced with the negative feedback loop from the center point of the output transistors to the base of the driver transistor.

Caution: The output stage is not damaged by an open-circuited load, but the output transistors are destroyed by short circuits across the output load, or by load impedances smaller than 3.5 Ohms. Chassis shorts from the transistor casings also lead to immediate destruction of these transistors. It is therefore quite essential to disconnect the mains plug before commencing work on the output stages.

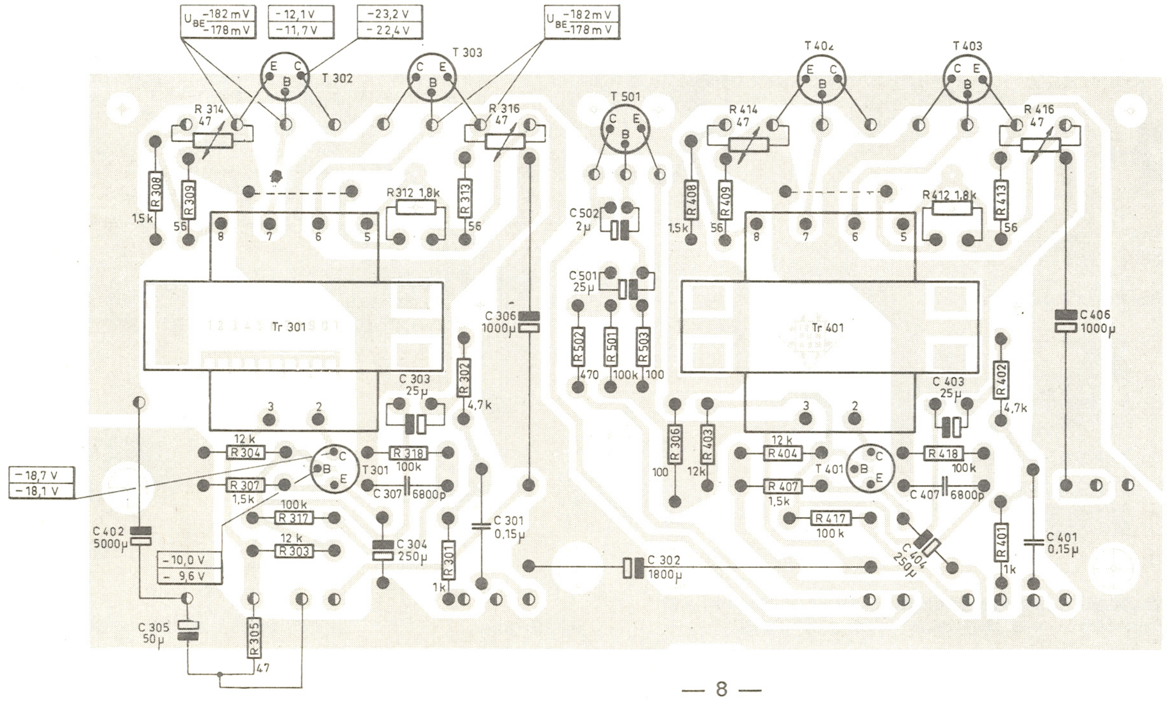
Continued on Page 17

Amplifier Board Looking onto printed wiring side approx. as from Serial No. 32 600

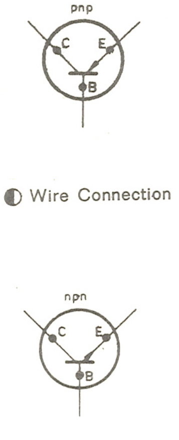


R 251
R 151
R 103
L 101
R 102
+ 2,3 V
L 103
- 13,3 V
- 13,3 V
C 129 0,22 μ
R 251 50k
R 103 10k
R 154 82
R 151 50k
R 102 10k
R 156 270
100 k R 153
T 107
C 128 0,01μ
R 152 1,8k
L 103
C 131 0,01μ
- 9,3 V
- 8,9 V
C 103 100μ
R 112 3,3k
- 12,0 V
- 11,4
C 118 250μ
R 136 1k
C 127 50μ
L 101
C 104 2200p
OA150
D 101
R 113
R 147 15k
C 101 1500p
- 2,4 V
- 2,2 V
12 k R 115
R 118 82 k
C 126 1μ
- 6,4 V
- 6,0 V
- 18,7 V
- 18,1 V
C 123 0,15μ
R 146 27k
R 144 56 k
C 122 0,033μ
C 125 470p
S 301
S 101
- 1,3 V
- 1,3 V
R 104 220 k
56 k R 106
8,2 k R 108
C 116 1000p
C 111 0,033 μ
T 103
T 104
T 106
C 119 100μ
C 114 0,047μ
R 138 1,5 k
R 139 2,7 k
R 134 220
R 141 15 k
R 128 100
R 124 120
R 127 10
R 126 100
C 102 10μ
T 101
C 106 2μ
C 109 2μ
3,3 k R 121
39 k R 114
R 131 4,7 k
R 142 2,7 k
C 124 100μ
C 113 0,068μ
- 2,1 V
- 2,1 V
18 k R 107
R 111 100
R 109 8,2 k
C 107 50μ
R 119 470
T 102
C 117 25μ
C 112 100μ
18 k R 116
R 122 220
R 129 39 k
R 137 5,6 k
C 120 1000p
R 143 560
R 145 2,2k
C 121 250μ
R 132 470
R 133 150
L 102
L 102
- 7,0 V
- 6,8 V
R 123 3,3 k
- 3,6 V
- 3,4 V
R 219 1k
C 210 1000p
- 8,4 V
- 8,5 V
C 203 100p
C 204 2200
L 201
R 219
C 201 1500p
R 203 10 k
R 213 3,3 k
C 226 1μ
C 223 0,15μ
R 246 27k
R 244 56k
C 222 0,033μ
C 225 470p
15 k R 247
R 203
S 201
R 204 220 k
56 k R 206
8,2 k R 208
C 216 1000p
3,3 k R 221
39 k R 214
T 203
T 204
T 206
R 231 4,7 k
R 242 2,7 k
C 224 100μ
OA 150
D 201
C 214 0,047μ
C 213 0,068μ
R 238 1,5 k
R 239 2,7 k
R 234 220
R 241 15k
R 228 100
R 224 120
R 227 10
R 226 100
C 202 10μ
T 201
R 209 8,2 k
C 206 2μ
C 209 2μ
R 223 3,3 k
T 202
C 219 100μ
C 227 50μ
18 k R 207
R 211 100
C 207 50μ
C 212 100μ
18 k R 216
R 222 220
C 217 25μ
R 229 39 k
R 237 5,6 k
R 243 560
C 220 1000p
R 245 2,2 k
C 221 250μ
R 232 470
R 233 150
L 202
L201
L 202

Output Stage Board Looking onto printed wiring side approx. as from Serial No. 32 600



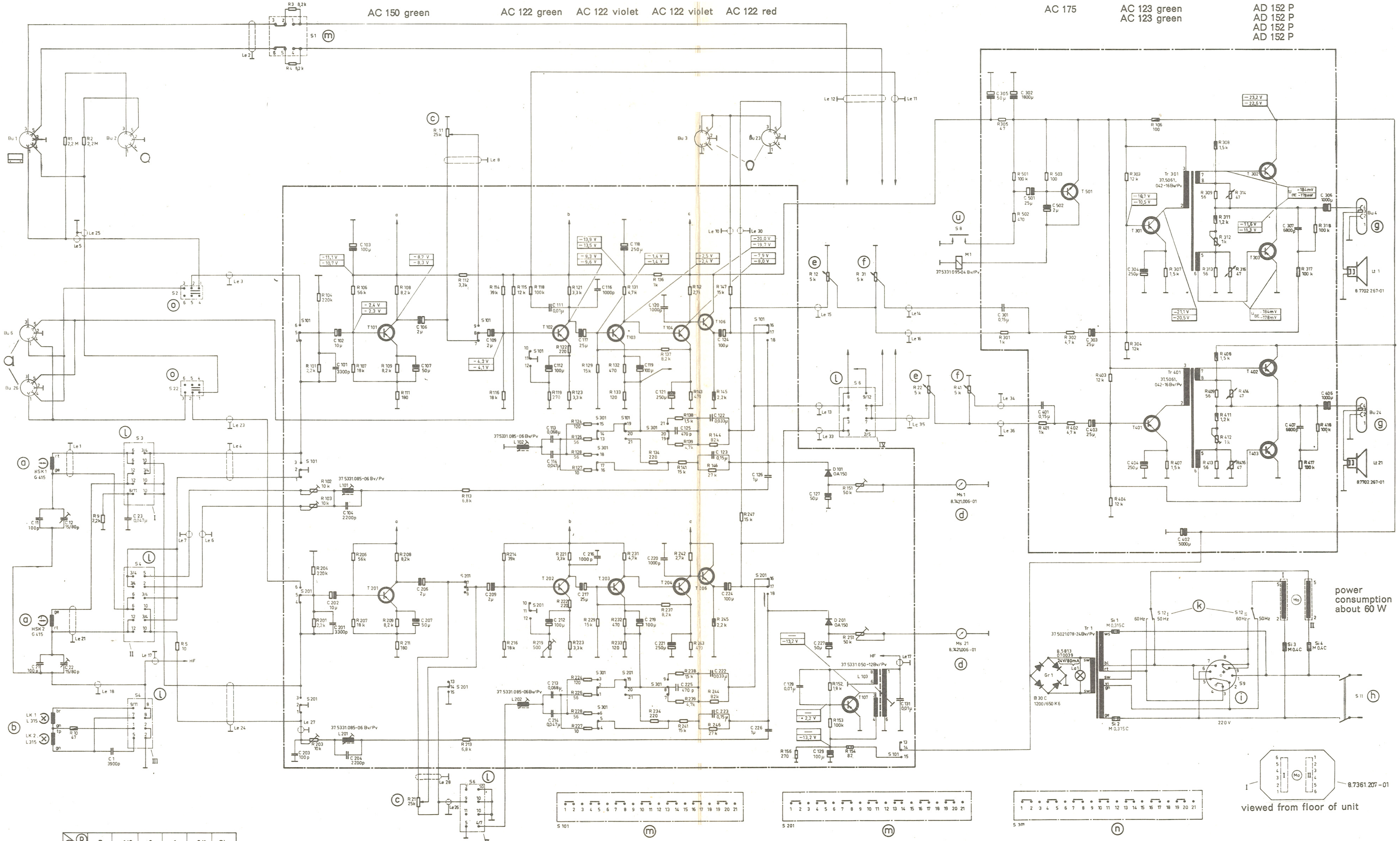
U_{BE} -182 mV -178 mV
- 12,1 V
- 11,7 V
- 23,2 V
- 22,4 V
U_{BE} -182 mV -178 mV
T 302
T 303
T 501
T 404
T 403
R 314 47
R 316 47
R 414 47
R 416 47
R 308 1,5 k
R 309 56
R312 1,8k
R 313 56
C 502 2μ
R 408 1,5k
R 409 56
R412 1,8k
R 413 56
Tr 301
C 306 1000μ
C 501 25μ
R 502 470
R 501 100k
R 503 100
Tr 401
C 406 1000μ
C 303 25μ
R 302 4,7k
C 403 25μ
R 402 4,7k
12 k R 304
T 301
R 318 100k
R 306 100
R 403 12k
12 k R 404
T 401
R 418 100k
- 18,7 V
- 18,1 V
R 307 1,5k
C 307 6800p
R 407 1,5k
C 407 6800p
100 k R 317
C 301 0,15μ
R 417 100 k
C 402 5000μ
12 k R 303
C 304 250μ
R 301 1k
C 302 1800μ
C 404 250μ
R 401 1k
C 401 0,15μ
- 10,0 V
- 9,6 V
C 305 50μ
R 305 47



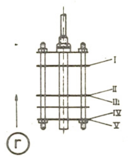
pnp
C
E
B
Wire Connection
npn
C
E
B

Circuit Diagram magnetophon 204 E

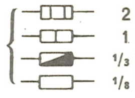
a	Record / Playback Head
b	Erase Head
c	Drive Level Control
d	VU-Meter Ms 1, Ms 21
e	Volume Control
f	Tone Control
g	Loudspeaker Connection 10 Ω (minimum 4 Ω), Bu 4, Bu 24
h	On/Off Switch, S 11
i	Voltage Selector, S 9
k	50 Hz / 60 Hz Changeover Switch, S 12 I, S 12 II
l	Function Selector Switch, S 3, S 4, S 6
m	Recording Switch, S 101 stereo, mono S 201 stereo Playback Switch, S 1 depicted switch setting: playback)
n	Equaliser Changeover Switch, S 301 (depicted switch setting: 9.5 cm/s)
o	Radio/Microphone Switch, S 2, S 22 (depicted switch setting: Radio)
p	setting
q	wafer
r	direction of viewing
s	All switch wafers viewed from floor of unit, depicted switch setting: Parallel
t	coloured bar
u	tape end contact, S 8


AC 150 green
AC 122 green
AC 122 violet
AC 122 violet
AC 122 red
AC 175
AC 123 green
AC 123 green
AD 152 P
AD 152 P
AD 152 P
AD 152 P
power consumption about 60 W
viewed from floor of unit
8.7361.207-01
S 101
S 201
S 301

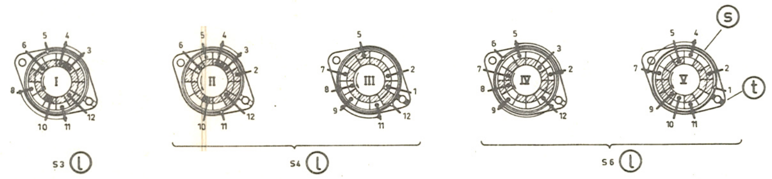
(q) \ (p)	P	1/2	2	1	2/1	St
I	3/4-6	6-10-8/11	6-10	10-12	8/11-10-12	10-12
	3/4-10-12	3/4-12	3/4-12	3/4-6	3/4-6	3/4-6
II	3/4-6	6-10	6-10	10-12	10-12	10-12
	2-3/4-10-12	2-3/4-12	2-3/4-12	3/4-5-6	3/4-5-6	3/4-5-6
III	-	7-8	7-8	8-9/11	8-9/11	8-9/11
	-	1-2	1-2	1-2	1-2	2-5
IV	7-8	7-8-9/12	7-8	7-8	8-9/12	-
	-	3-2/5	-	-	3-2/5	3-7
V	5-9	9-10	9-10-11	9-10-11	9-10	2-10
	-	-	5-4/7	5-4/7	-	5-4/7

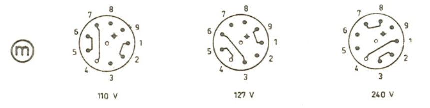

I
II
III
IV
V
r

power ratings of resistors


2 W
1 W
1/3 W
1/8 W

sw: black	bl: blue
br: brown	vi: violet
rt: red	ws: white
ge: yellow	tp: transparent (colourless)
gn: green	


I
II
III
IV
V
s
t
S3 l
S4 l
S6 l


m
110 V
127 V
240 V

30.0155.0 B

Playback Recording	Voltage readings specified as obtained with a 50 kΩ/V meter, without AF signal

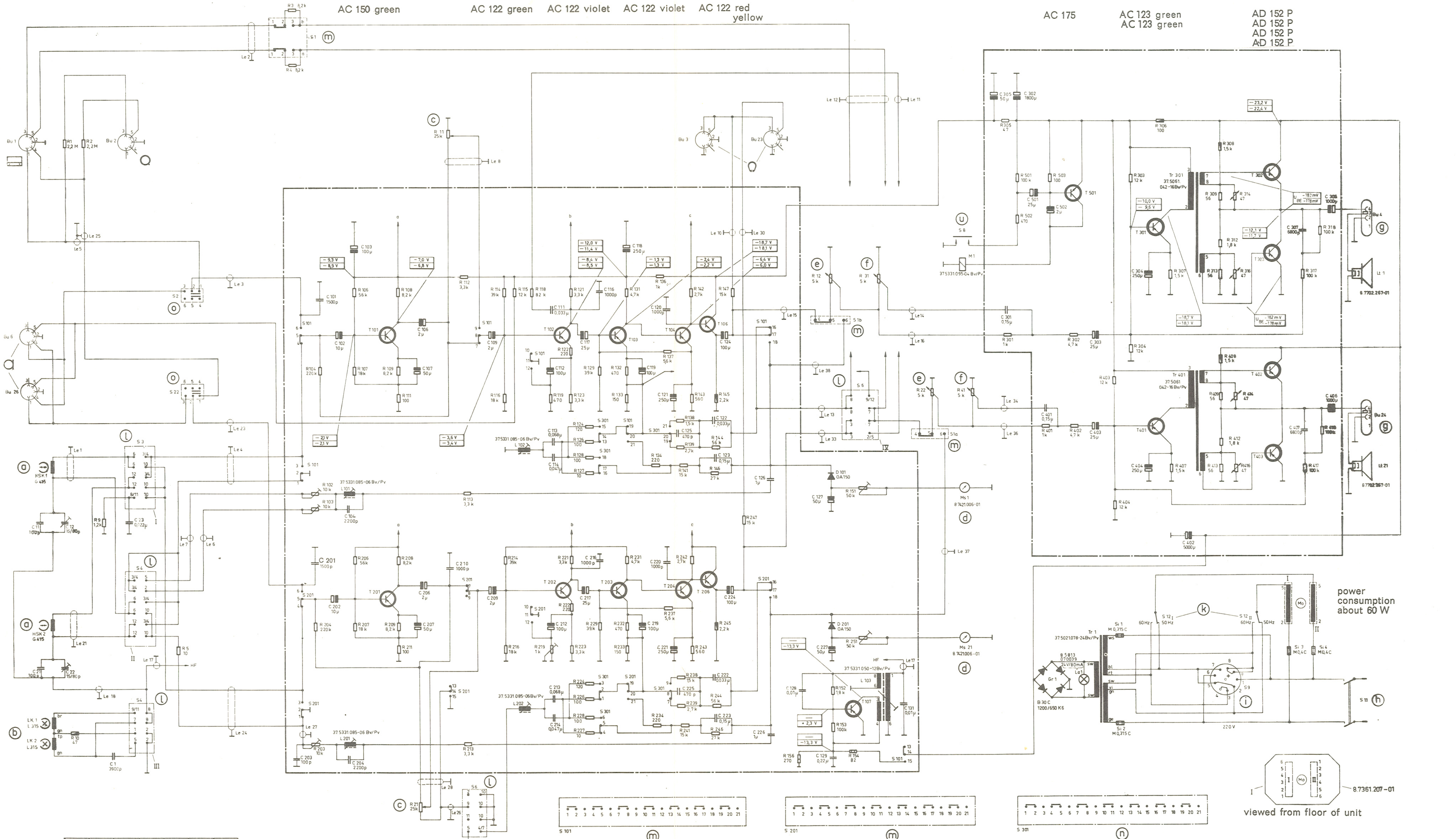
AC 150 green AC 122 green AC 122 violet AC 122 violet AC 122 red AC 124 P III

We reserve the right to make circuit modifications

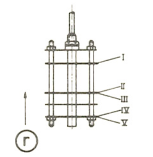
Circuit Diagram magnetophon 204 E

approx. as from Serial No. 32 600

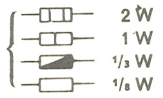
a Record / Playback Head
b Erase Head
c Drive Level Control
d VU-Meter Ms 1, Ms 21
e Volume Control
f Tone Control
g Loudspeaker Connection 10 Ω (minimum 4 Ω), Bu 4, Bu 24
h On/Off Switch, S 11
i Voltage Selector, S 9
k 50 Hz / 60 Hz Changeover Switch, S 12 I, S 12 II
l Function Selector Switch, S 3, S 4, S 6
m Recording Switch, S 101 stereo, mono
S 201 stereo
Playback Switch, S 1
depicted switch setting: playback)
n Equaliser Changeover Switch, S 301 (depicted switch setting: 9.5 cm/s)
o Radio/Microphone Switch, S 2, S 22 (depicted switch setting: Radio)
p setting
q wafer
r direction of viewing
s All switch wafers viewed from floor of unit, depicted switch setting: Parallel
t coloured bar
u tape end contact, S 8


AC 150 green
AC 122 green
AC 122 violet
AC 122 violet
AC 122 red
yellow
AC 175
AC 123 green
AC 123 green
AD 152 P
AD 152 P
AD 152 P
AD 152 P
power consumption about 60 W
viewed from floor of unit
8.7361.207-01
S 101
S 201
S 301

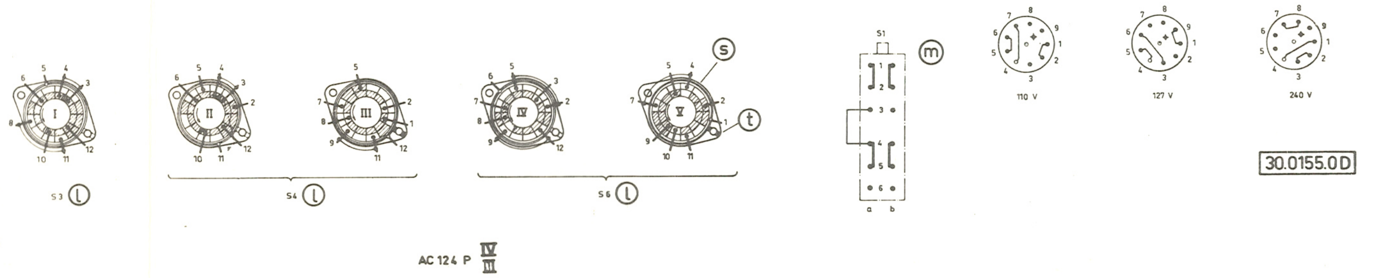
ⓠ ⓟ	P	1/2	2	1	2/1	St
I	3/4-6	6-10-8/11	6-10	10-12	8/11-10-12	10-12
	3/4-10-12	3/4-12	3/4-12	3/4-6	3/4-6	3/4-6
II	3/4-6	6-10	6-10	10-12	10-12	10-12
	2-3/4-10-12	2-3/4-12	2-3/4-12	3/4-5-6	3/4-5-6	3/4-5-6
III	-	7-8	7-8	8-9/11	8-9/11	8-9/11
	-	1-2	1-2	1-2	1-2	2-5
IV	7-8	7-8-9/12	7-8	7-8	8-9/12	-
	-	3-2/5	-	-	3-2/5	3-7
V	5-9	9-10	9-10-11	9-10-11	9-10	2-10
	-	-	5-4/7	5-4/7	-	5-4/7


I
II
III
IV
V
r

power ratings of resistors


2 W
1 W
1/3 W
1/8 W

sw: black	bl: blue
br: brown	vi: violet
rt: red	ws: white
ge: yellow	tp: transparent (colourless)
gn: green	


s
t
S 3 l
S 4 l
S 6 l
S1
m
a
b
110 V
127 V
240 V
30.0155.0D
AC 124 P
IV
III

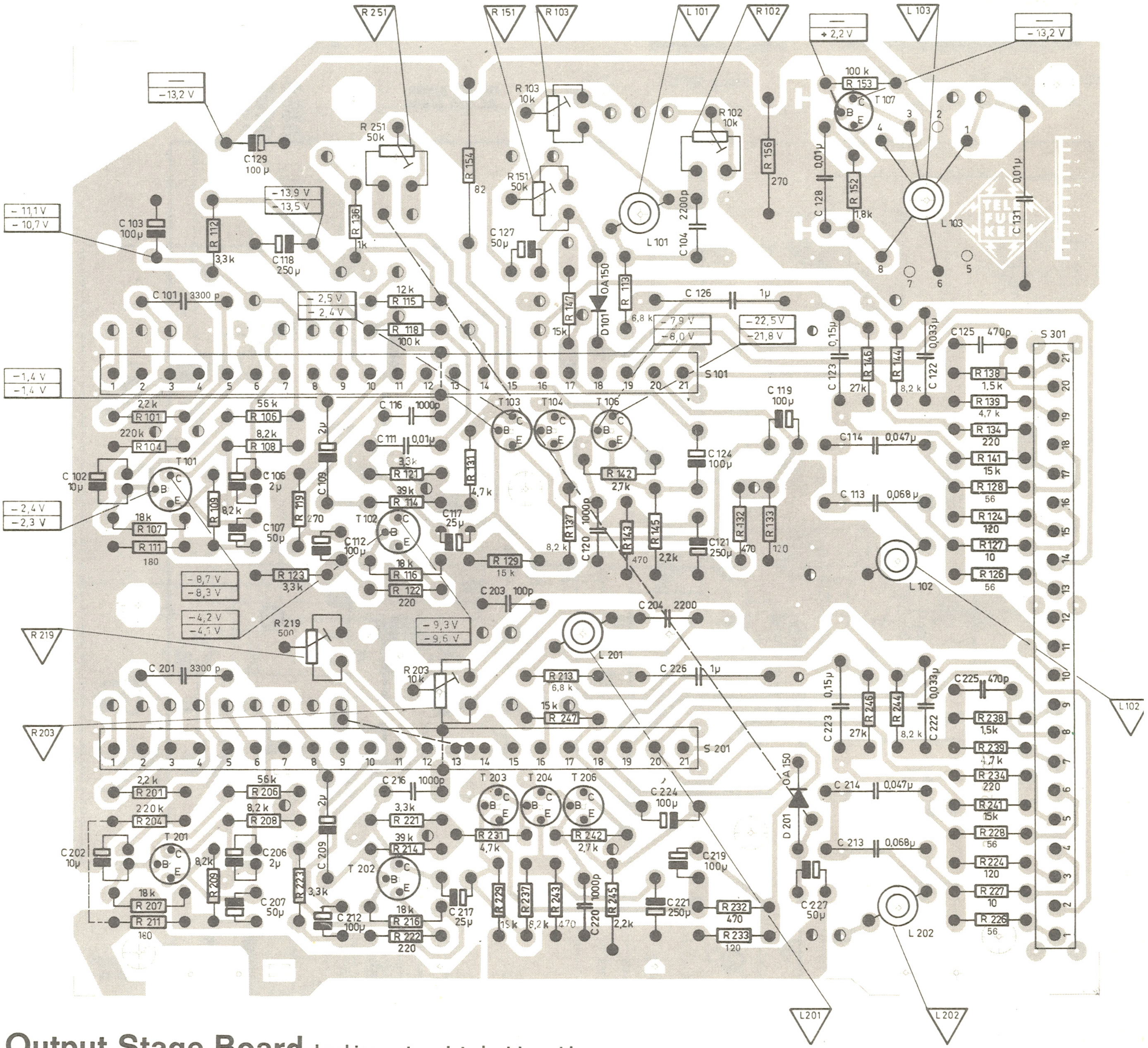
▭ Playback
▭ Recording

Voltage readings specified as obtained with a 50 kΩ/V meter, without AF signal

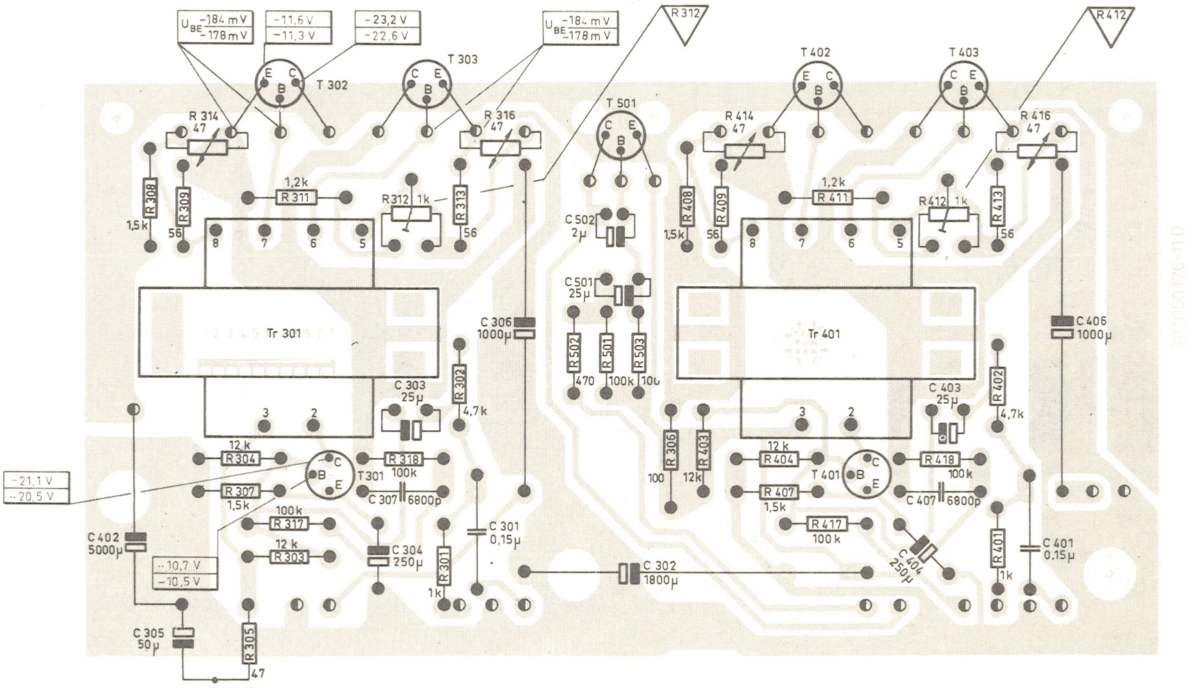
AC 150 green AC 122 green AC 122 violet AC 122 violet AC 122 red yellow

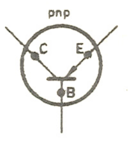
We reserve the right to make circuit modifications

Amplifier Board Looking onto printed wiring side

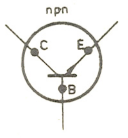

R 251
R 151
R 103
L 101
R 102
+ 2,2 V
L 103
– 13,2 V
– 13,2 V
– 11,1 V
– 10,7 V
– 13,9 V
– 13,5 V
– 2,5 V
– 2,4 V
– 7,9 V
– 8,0 V
– 22,5 V
– 21,8 V
– 1,4 V
– 1,4 V
– 2,4 V
– 2,3 V
– 8,7 V
– 8,3 V
– 4,2 V
– 4,1 V
– 9,3 V
– 9,6 V
R 219
R 203
L 102
L 201
L 202
S 101
S 201
S 301
T 101
T 102
T 103
T 104
T 106
T 107
T 201
T 202
T 203
T 204
T 206
D 101
D 201

Output Stage Board Looking onto printed wiring side


U$_{BE}$ –184 mV
–178 mV
–11,6 V
–11,3 V
–23,2 V
–22,6 V
U$_{BE}$ –184 mV
–178 mV
R 312
R 412
T 302
T 303
T 501
T 402
T 403
Tr 301
Tr 401
T 301
T 401
–21,1 V
–20,5 V
–10,7 V
–10,5 V



◐Wire Connectio



List of Replacement Components for magnetophon 204 E

A. Cabinet and control parts

Pos. Nr.	Item	Spare part No.	Price group
1	lid, compl.	339 005 603	M
3	screw for metal plate	339 925 015	H +
4	rear cover (for heads)	339 126 622	C
5	front cap, compl.	339 126 620	M
6	spring for lid	339 913 701	N +
7	metal covering plate	339 120 606	L
8	knob for six functions selector	339 205 602	F
9	control knob	339 200 605	B
10	screw bushing for front cap	339 949 009	N +
10a	screw bushing for metal covering plate	339 949 008	K +
11	level meter	339 370 601	M
12	Pause-button	339 210 620	V +
13	speed changeover knob	339 215 604	T +
14	push-button red (record)	339 210 614	W +
15	push-button STOP	339 210 619	W +
16a	push-button PLAYBACK	339 210 612	W +
16b	push-button FORWARD	330 210 613	W +
16c	push-button REVERSE	339 210 611	W +
17	push-button assy., compl.	339 700 605	N
18	solenoid for tape end off switching	339 340 603	G
19	case slider	339 060 607	A +
20	sign plate for sockets	339 070 607	E
21	bottom plate, compl. (metal)	339 010 603	J
22	carrier handle, compl.	339 015 605	N
23	rubber foot with screw	339 060 501	R +
24	wooden frame with speaker grill, without handle	339 025 606	Y
25	speaker grill	339 045 602	F
26	loudspeaker	339 320 605	N
28	cover plate for pos. 21	339 870 617	P +
29	rubber cap for tape reel	339 220 602	P +
30	mains switch	339 440 610	H
31	plastic foot for wooden frame (on the corner of the frame)	339 060 701	K +
32	plastic cover for sockets plate, from serial No. 346 286 22	339 126 625	U +

B. Head assy-plate

Pos. Nr.	Item	Spare part No.	Price group
40	record/playback head G 415	339 350 603	Q
41	balance plate for head, compl.	339 725 708	A
42	erase head holder	339 725 710	P +
43	erase head L 315	339 355 603	N
44	rubber buffer	339 725 714	H +
45	head assy. plate compl.	339 720 607	J
	for chassis with 6 mm capstan	339 720 707	R
46	brake lever, compl.	339 745 705	P +
46a	rubber for brake lever	339 745 706	K +
47	tape holder (wire arch)	339 725 711	N +
48	brake slider plate	339 825 712	T +
49	toggle lever	339 825 713	A
50	humflap	339 725 709	A
51	tape guide roller	339 725 712	G
52	bracket for capstan bearing with bearing, compl.	339 715 604	T +
52	bracket with capstan bearing for chassis with 6 mm capstan	339 715 707	T +
53	tape end contact	339 725 605	E
54	lever for Pause switch	339 825 714	K +
55	rubber idler lever, compl.	339 750 703	J
56	friction wheel slider	339 765 704	V +
57	friction wheel	339 760 705	G

C. Turntable

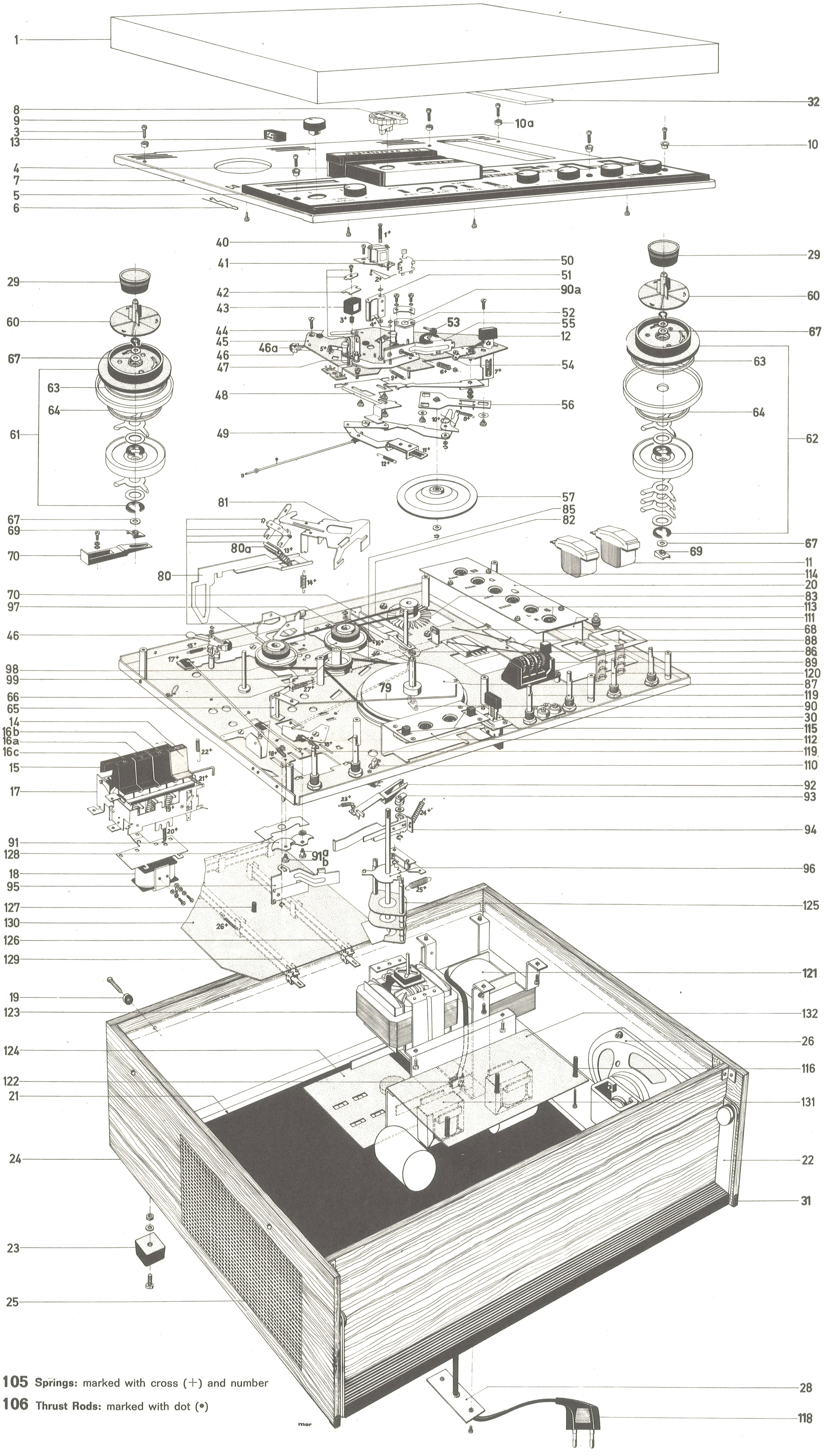
Pos. Nr.	Item	Spare part No.	Price group
60	disk for reel	339 740 708	A
61	turntable, left, compl.	339 740 712	I
62	turntable, right, compl.	339 740 711	J
63	felt strip, 229 m	339 740 718	N +
64	felt strip, 176 mm	339 740 719	K +
65	brake lever for turntable left (Pause)	339 745 606	B
66	brake lining for lever	339 745 607	H +
67	Ultramid-washer for turntable axle	339 942 018	H +
68	felt for additional brake (turnable right)	339 745 608	H +
69	sliding block	339 740 722	K +
70	slider for height adjusting	339 740 723	K +

D. Mechanical parts

Pos. Nr.	Item	Spare part No.	Price group
79	rod for brake lever (Pause)	339 825 718	P +
80	tape speed changeover assy.	339 770 701	D
80a	switching piece for pos. 80 (plastic, black)	339 770 702	K +
81	rocker	339 770 703	V +
82	motor belt	339 730 707	F
82	drive belt for motor (new type) (for all sets)	339 730 711	E
83	motor fan with drive pulley for motor belt 50/60 cps.	339 735 707	B
84	rubber sleeve for fan	339 735 708	V +
85	flywheel belt	339 730 708	E
86	dust protecting ring for flywheel	339 715 603	K +
86	dust protecting ring for flywheel for chassis with 6 mm capstan	339 715 708	K +
87	Flywheel	339 710 604	O
87	flywheel for chassis with 6 mm capstan	339 710 705	B
88	counter belt	339 730 709	B
89	counter	339 780 701	L
90	capstan bearing (lower part) without spur bearing	339 715 608	D
90	capstan bearing (lower part) without spur bearing for chasis with 6 mm capstan	339 870 713	D
90a	spur bearing for pos. 90	339 715 609	P +
90a	spur bearing for pos. 90 for chassis with 6 mm capstan	339 715 709	N +
91	blocking rocker	339 825 711	K +
91a	set screw for blocking rocker, long	339 920 702	K +
91b	set screw for blocking rocker, short	339 920 701	H +
92	lifting lever	339 870 705	P +
93	sliding block	339 870 706	K +
94	switching lever 2	339 825 715	R +
95	switching lever 1	339 825 716	R +
96	ratched for selector switch	339 825 709	N +
97	rubber ring for intermediate wheel	339 735 711	N +
98	intermediate wheel	339 760 704	G
99	speed changeover wheel, metal, for chassis with 8 mm capstan	339 760 707	G
99	speed changeover wheel, metal, for chassis with 6 mm capstan	339 760 708	G

E. Springs

Pos. Nr.	Item	Spare part No.	Price group
105	1 set of springs (5 each)	339 915 717	H
	+ 1 spring for head balance	339 905 724	K +
	+ 2 spring for hum flap	339 915 714	R +
	+ 3 pressure spring for erasing head	339 905 723	H +
	+ 4 spring for tape guide roller	339 915 704	R +
	+ 5 tension spring for brake lever	339 900 707	H +
	+ 6 pressure spring for rubber idler lever	339 905 706	K +
	+ 7 pressure spring for Pausebutton	339 905 725	K +
	+ 8 tension spring for friction wheel slider	339 900 703	H +
	+ 9 tension spring for brake slider	339 900 721	H +
	+ 10 torsion spring for quick stop	339 910 724	K +
	+ 11 pressure spring for toggle lever	339 905 705	H +
	+ 12 tension spring for toggle lever	339 900 712	K +
	+ 13 pressure spring for speed changeover switch	339 905 722	K +
	+ 14 tension spring of changeover rocker	339 900 710	N +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105 **Springs:** marked with cross (+) and number

106 **Thrust Rods:** marked with dot (•)

mer

Pos. Nr.	Item	Spare part No.	Price group
	+ 15 tension spring for brake, left	339 900 619	K +
	+ 16 tension spring for forward lever	339 900 603	K +
	+ 17 clamp spring for switching rod	339 915 713	H +
	+ 18 pressure spring for connecting rod	339 905 703	H +
	+ 19 pressure spring for pushbutton lever	339 905 707	K +
	+ 20 tension spring for rest flap	339 900 706	N +
	+ 21 tension spring for pushbutton lock	339 900 723	K +
	+ 22 tension spring for stop button	339 900 724	K +
	+ 23 tension spring for lifting slider	339 900 711	K +
	+ 24 tension spring for switching lever	339 900 719	K +
	+ 25 tension spring for notched lever	339 900 705	N +
	+ 26 tension spring for recording slider	339 900 722	K +
	+ 27 tension spring for additional brake and reverse lever	339 900 602	P +
106	1 set of 5 rods (one each)	339 825 717	B
	1 set of plastic washers 5 each	339 942 021	F
	1 set of metal washers 5 each	339 940 014	T

F. Electrical parts

110	sliding switch with spring	339 440 603	C
111	sockets carrier, compl.	339 420 605	L
112	bracket with mic. sockets and 2 switches	339 420 606	L
113	loudspeaker socket LB 3	339 540 001	V +
114	5 pole socket	339 540 014	A
115	Radio/Micro-switch	339 440 604	A
116	distance tube, black	339 935 017	K +
118	mains lead	339 480 603	E
119	potentiometer 5 KOhms R 12/22/31/41	339 500 608	F
120	potentiometer 25 KOhms R 11/21	339 500 703	J
121	mains transformer	339 310 602	P
122	clamp for mains lead	339 870 707	H +
123	shaded pole-motor E 98, U 28/2 50/60 cps.	339 300 607	S
124	voltage selector plate	339 410 607	I
125	six-functiones selector	339 440 609	M
126/129	slider for switch S 101/201	339 400 608	G
127	distance tube, yellow	339 935 015	K +
128	slider for switch S 301	339 400 607	F
	metal holder for sliding switches S 101/201/301	339 870 703	K +
130	amplifier plate	339 330 607	Z
130	amplifier plate, compl. (new type)	339 330 709	Z
131	intermediate transformer	339 315 611	K
132	power plate, compl.	339 335 606	Z
132	power plate, compl. (new type)	339 335 703	Z

Nr. Pos.	Item	Spare part No.	Price group
133	oscillator coil	339 345 603	H
134	variable coil	339 345 604	G
135	ferrite core for pos. 134	339 450 604	P +
136	pot core 18 x 14 for pos. 133	339 450 603	F
137	thermistor 47 Ohms 20 %	339 530 005	F
138	twin ceramic trimmer B 15 / 80 N 1500	339 510 003	A
139	fuse M 0.4 C DIN 41 571	339 570 006	P +
140	fuse M 0.315 C DIN 41 571	339 570 005	P +
141	selenium rectifier B 30 C 1200/650 K 6	339 520 016	I
142	bulb fitting, compl.	339 560 005	D
143	miniature bulb 24 V 80 mA	339 560 002	C
144	variable resistor 1 KOhms R 312/412/219	339 505 707	A
145	variable resistor 10 KOhms R 102/103/203	339 505 703	B
147	variable resistor 50 KOhms R 151/251	339 505 702	B
149	electrolytic capacitor 100 µF 15/18 V ins. C 124/224	339 584 032	A
150	electrolytic capacitor 1800 µF 25 V ins. C 302	339 588 001	I
151	electrolytic capacitor 1000 µF 25 V C 306/406	339 586 018	L
152	electrolytic capacitor 100 µF 15/18 V C 103	339 584 026	B
153	electrolytic capacitor 100 µF 35/4 V C 129	339 584 017	C
154	electrolytic capacitor 250 µF 6/8 V C 121/221	339 586 002	A
155	electrolytic capacitor 250 µF 15/18 V C 118/304/404	339 586 003	B
157	electrolytic capacitor 10 µF 15/18 V C 102/202	339 582 006	A
158	electrolytic capacitor 25 µF 10/12 V C 117/217	339 582 010	C
159	electrolytic capacitor 25 µF 15/18 V C 303/403	339 582 015	A
160	electrolytic capacitor 25 µF 25/30 V C 501	339 582 016	B
161	electrolytic capacitor 50 µF 3/4 V C 127/227	339 584 013	D
162	electrolytic capacitor 50 µF 6/8 V C 107/207	339 584 012	A
163	electrolytic capacitor 100 µF 3/4 V C 112/119/212/219	339 584 028	A
164	electrolytic capacitor 5000 µF 35 V ins. C 402	339 588 004	M
165	diode OA 150 D 101/201	339 527 002	A

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The VU-Meter Circuit

A capacitor (C 127 / C 227) is connected via a diode (D 101 / D 201) to the output (C 124 / C 224) of each amplifier. The negative half-cycles of the AF output voltage cause the diode to conduct, so that the capacitor rapidly charges via the low forward resistance of the diode to the peak value of the AF voltage. The resulting DC voltage causes a current to flow via a preset resistor and the VU-meter to chassis. The discharge time-constant of the circuit is about 2.5 seconds and the charging time-constant is about 0.15 seconds.

The Oscillator

The single-ended RF oscillator is switched on for the recording function by applying the supply voltage. The transistor T 107 operates in a grounded emitter circuit and employs inductive positive feedback. The oscillation frequency is determined chiefly by the inductance of the coil L 103, the inductance of the erase head and the capacitance of C 131. The different loadings of the oscillator for mono or stereo operation due to the erase heads are compensated by connecting a resistor R 10 or a capacitor C 1. The bias voltage is fed to the record/playback heads via the trimmers (C 12 / C 22).

End Switch-Off

The switching foil at the start and end of the tape closes the charging circuit of an electrolytic capacitor (C 501) via the tape end contact (S 8). The electrolytic capacitor lies in the base circuit of an npn transistor which is thus made to conduct and energise the stop solenoid for the duration of the charging process. For renewed actuation of the stop function, the charging circuit must first be broken again, so that the electrolytic capacitor can discharge through R 501.